UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science

BSc Environmental Health Science

MAIN EXAMINATION PAPER MAY 2012

TITLE OF PAPER	:	WATER DRAINAGE AND SEWERAGE
COURSE CODE	:	EHS:587
DURATION	:	2 HOURS
MARKS	:	100
INSTRUCTIONS	:	THERE ARE FIVE QUESTIONS IN THIS EXAM
	:	ANSWER ANY FOUR OUT OF THE FIVE QUESTIONS
	:	EACH QUESTION CARRIES A MAXIMUM OF 25 MARKS
	:	NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE EXAMINATION ROOM

QUESTION ONE (25 Marks)

A. Define the following terms: i) Brown water ii) Infiltration iii) Inflow   iv) Combined sewer overflow (CSO) and v) Peak flow factor.   ……………………………….…..[5 Marks]

B. Discuss the advantages and disadvantages of i) separate sewer systems ii) combined sewer systems. ……………………………….…………...…………………………….[5 Marks]

C. Describe for cast-in-place sewers, how the shape of sewer may be modified so that it is able to achieve self-cleansing velocity both during peak flow time and minimum flow time

…………...…..[5 Marks]

D. Explain how the laying out of sewer takes under condition that the sewer has to be laid above a water supply pipe because of constraints imposed by gravity flow. ……...[5 Marks]

E. For the layout of sewer shown in Figure Q1e below, identify the sewer components that each of the letters designated from A to H represent ……………………………..[5 Marks]

Figure Q1e

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QUESTION TWO (25 Marks)

A. Describe briefly what aspects you would look in the <u>preliminary reconnaissance survey</u> for the design of sewer system for a given city. ....[5 Marks]

B. Discuss the importance of the following pieces information to be acquired for the design of a sewerage system for a given city:

   i. Ordnance survey maps of 1:50,000 to 1:100,000 scale as well as maps at scales of 1:10,000 to 1:25,000.

   ii. Rainfall intensity and temperature data

   iii. Population statistics

   iv. Geology, trial holes and borings. ....[5 Marks]

C. Compare and contrast the following sewer pipe materials in terms of their suitability, condition of operation, jointing, etc.

   i) Vitrified clay   ii) Concrete pipe   iii)   iv) PVC pipe   v) ductile iron pipe.[5 Marks]

D. i)   How do you compare the bedding requirement of smaller sewer pipe compared to larger size sewer pipe?

   ii) State what will happen to a sewer pipe that is laid on unfavorable soil conditions such as wet clays and organic soils. State also the bedding requirements. ......[5 Marks]

E. Describe with the help of a sketch the process of crown corrosion of sewers. .[5 Marks]

QUESTION THREE (25 Marks)

A. Describe the procedure for manually maintaining the line and grade of a sewer during construction. ....[5 Marks]

B. State the excavation requirements of i) ball and spigot jointed sewer pipe and ii) a rock trench bottom. ....[5 Marks]

C. Describe the sheeting and bracing techniques employed for the construction of sewer line trench. ....[5 Marks]

D. Describe the various cleaning mechanisms employed for the removal from sewer pipes of i) roots ii) grease iii) sand and grit. ....[5 Marks]

E. Describe

      i.   the sources of gases in sewers, the danger they pose and the precaution that has to be taken during sewer maintenance.

     ii.   The method of control of odours in sewers.

          .... [5 Marks]

QUESTION FOUR (25 Marks)

A. How do you compare the advantages and disadvantages of open channel drainage schemes with that of closed conduits? Indicate any modification to make open channel drainage more acceptable. ....[5 Marks]

B. Discuss the problems of providing sustainable drainage system in developing countries.
...........[10 Marks]

C. Describe with the help of s sketch i) Catch basins and ii) Drop structure. .....[5 Marks]

D. Discuss with the help of a sketch source control used for controlling runoff and flooding.
....[5 Marks]

QUESTION FIVE (25 Marks)

The minimum slope required to achieve self-cleansing velocity has been suggested as 0.0019 m/m for a sewer pipe diameter of 300 mm. In an area with a ground slope of 0.0019 a sanitary sewer is required to carry a flow of 0.06 m³/min. Using the discharge equation given in Eq. Q5-1 and the partial flow graph provided in Figure Q5-1 below:

   A. Determine if the suggested slope for the given diameter will achieve self-cleansing velocity of greater than or equal to 0.6 m/sec at the specified flow.   ....[20 Marks]

   B. Suggest what should be done in the event this self-cleansing velocity is not achieved.

   ....[5 Marks]

$$Q = \left(\frac{0.312}{n}\right) * D^{\frac{8}{3}} * S^{1/2} \quad \text{...(Eq. Q5-1)}$$

Where Q = sewer flow in m³/sec

   D = Sewer pipe diameter in meters

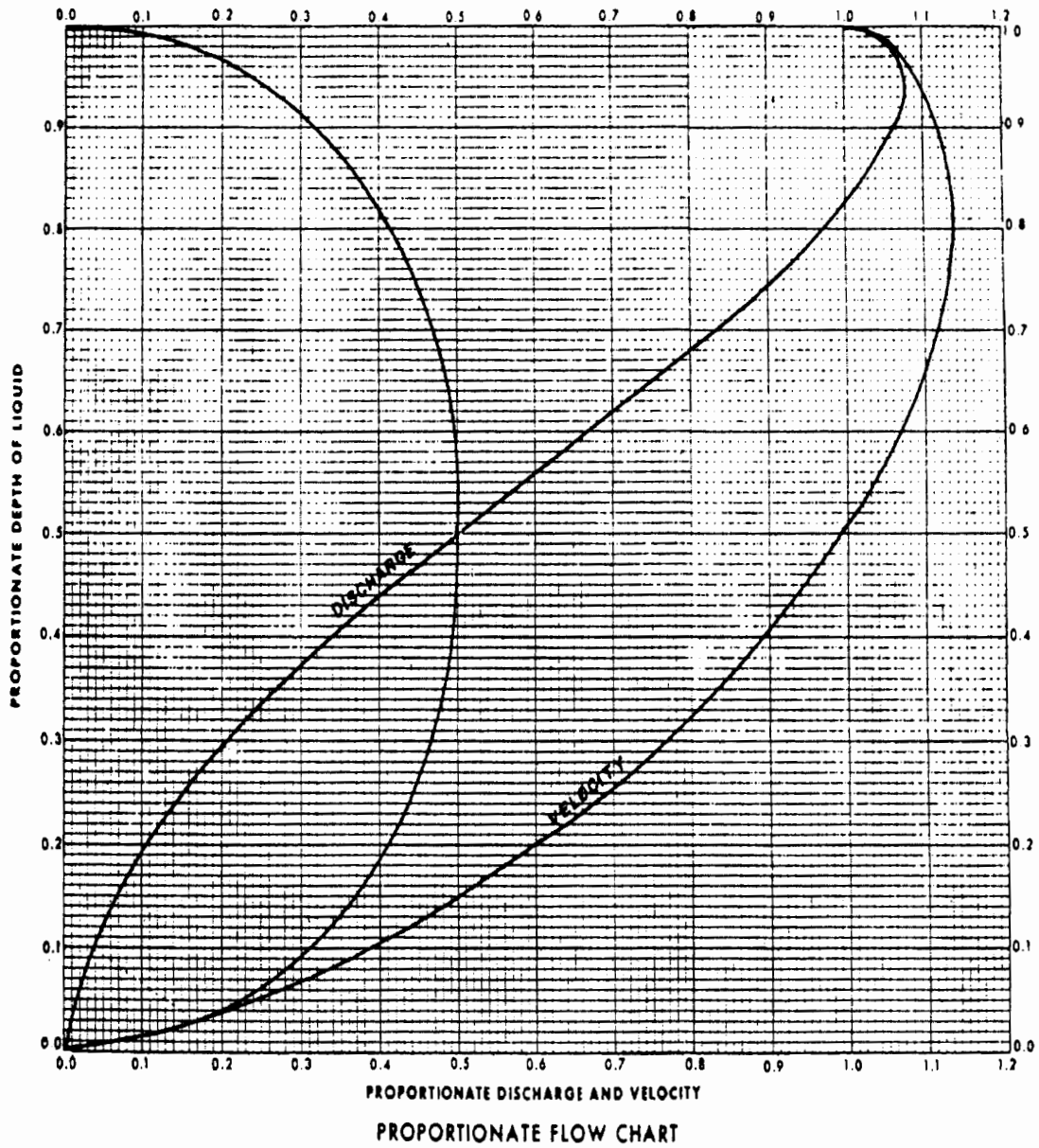   n = Manning's coefficient = 0.013

   S = Slope of sewer pipe (m/m).

PROPORTIONATE FLOW CHART

Figure Q5-1 Partial flow graph for Sewer flow calculation